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ANTI-ICING ARRANGEMENT

FOR THE MI-1A HELICOPTER

(Translation from the Russian)

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ANTI-ICING ARRANGEMENT

MI-1A

1. GENERAL INFORMATION

The anti-icing arrangement is designed to insure normal flight of the helicopter in icing conditions. The anti-icing prevents icing of the blades of the main as well as the tail rotor and the forward windshield of the cockpit. Prevention of the icing is based on the principle of creating a mixture of super-cooled water droplets deposited from the atmosphere and the alcohol supplied to the freezing surfaces. The freezing temperature of these mixtures and therefore the temperature down to which the prevention of icing works, depends on the relationship of the amount of water and alcohol in the formed mixture. The less the intensity of the deposit of super-cooled water droplets from the atmosphere and the more the supply of alcohol to the protected surface, the lower is the temperature down to which the protection of the icing is provided. Conversely, the higher the intensity of the deposit of the droplets and the less supply of the alcohol, the higher is the temperature at which the anti-icing ceases to operate.

In the helicopter MI-1A the amount of the supply of alcohol is such that at the higher output of the pump and maximum deposit of the droplets possible at the given temperature, the prevention of icing occurs down to -20° C.

Pure alcohol of 95 to 96% concentration is supplied to the surfaces to be protected against icing.

The supply of alcohol is started at the first sign of icing on the windshield or on other protruding parts of the helicopter, also when abnormalities of the helicopter (shaking of the control stick, vibration of the helicopter) occur.

In order to insure the supply of the alcohol to the surfaces of the main and tail rotor blades and to the windshield the helicopter has two independent systems.

2. ALCOHOL SUPPLY SYSTEM TO THE SURFACES OF THE MAIN AND TAIL ROTOR BLADES

The alcohol supplied to the blades of the main and tail rotors is contained in the tank (#18) Figure 1, attached by means of bands and brackets in the tail boom on the left side.

The welded tank containing 28 liters is made out of АМЦА material, is basically cylindrical and has two internal open partitions. In the upper part of the tank there is a filler (#17) containing a filter, a cap and a dipstick and the connection (#14) which connects the tank to the atmosphere via the draining pipe (#21) and fitting (#15) which connects the drain pipe of the pump to the tank.

In the lower part of the tank are located fitting (#16) for the connection of the tank to the intake line of the pump and fitting (#19) for the drainage of alcohol from the tank.

Under the tank (#18) on and aluminum alloy bracket attached at location (#6) of the tail boom is the alcohol pump (#20) Type СЦН-1, which supplies alcohol from the tank to the blade surfaces of the main and tail rotors.

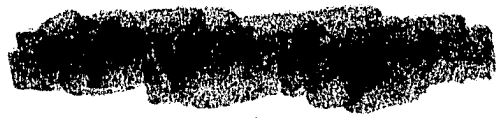
The centrifugal pump СЦН-1 consists of a D.C. electric motor МВП-1А, attached to the pump body, an impellor attached to the shaft of the electric motor, the pump housing, and the intake and outlet fittings.

In the body of the pump there is a pressure seal for the prevention of leakage of alcohol. The motor also has a pressure seal. Between the two pressure seals a small cavity is created in the pump body which is connected to the atmosphere with a drain tube. Alcohol which leaks through the pressure seal in the pump body is drained outside and cannot enter the motor.

In the upper part of the pump cover there is a fitting with an orifice to vent the alcohol vapors and air from the highest point of the pump into the upper part of the tank. The intake in the center of the cover is connected by the main line to the tank. The alcohol flows from the pump through the output fitting which includes the check valve.

The check valve is required to prevent the flow of alcohol from the main line due to the pressure column of the fluid and reduced pressure of the air near the output orifice when the pump is not operating, and also in order to prevent the return of alcohol from the main into the tank when the pump is temporarily shut off.

The electric motor МВП-1А has mixed windings for the excitation and a resistor to vary the shunt field. The motor has two working regimes - "normal" and "high". At the "normal" work regime when the resistor is disconnected from the shunt winding, the motor develops 8000 to 8300 rpm's. The "normal" regime of the motor provides protection against icing down to -10° C.



In the "high" regime, the motor develops up to 11,000 rpm. This "high" regime insures ice protection down to -20° C. At temperatures of -10° C and lower it is always mandatory to use "high" regime.

The outlet of the pump is connected through the check valve by tubing of 12 X 10 diameter made from АМГ to the filter СФ-1 (#13), combined with the regulating valve (#11) on the left side of the pylon.

The regulating valve regulates the amount of alcohol. It consists of body (#33), metering valve (#31), seal (#32), and three output fittings.

The metering valve, after it is adjusted, is locked by a check nut and sealed. There is a hydraulic line to connect the pressure switch to one of the output fittings.

The pressure switch СД-16А serves to warn the pilot when there is no longer any alcohol in the tank and for automatic shut-down of the pump СЦН-1. The pressure switch has diaphragm operated contacts. The diaphragm is spring loaded such that the switch closes at pressures on the diaphragm of .25 ± .02 Kilograms per square centimeter (3.8 ± .29 psi). The action of the switch is as follows: when the pump push buttom is depressed, the contactor 25A is energized and the electric motor is turned on together with a green light located in the cockpit. When the pump is operating the pressure of alcohol on the diaphragm connects the contacts of the switch СД-16А. The contacts of the switch short the push button contacts. Therefore with presence of the alcohol pressure the contactor К-25А is maintained in the switched-on condition by means of the contacts of the pressure switch СД-16А with the push buttom released.

If all alcohol in the tank is consumed the pressure of the alcohol drops, the contacts of the switch are opened switching off the contactor К-25А and also the pump СЦН-1 with the green light. The main supply line of the alcohol to the main and tail rotors is connected to the two other fittings of the regulating valve.

The main line of the alcohol supply to the blades of the main rotor is connected to the fitting (#29) attached to the stationary ring of the swash plate, from which the alcohol is conducted via tubing 6 x 4 to the jet (#30). The slinger of the main rotor (#10) is attached to the rotating ring of the swash plate. It consists of two discs welded together on their periphery and forming a (slinger) ring open on the inner diameter. To the outside of the slinger (periphery) are welded nine fittings which are connected to nine hoses, three for each rotor (connecting the slinger to the blades of the main rotor). The hoses are

attached by means of clamps on special brackets to the hinge pins. The slinger of the main rotor provides uniform distribution of alcohol to the blades as well as to the individual sections of each blade. The alcohol of the anti-icing system is forced by the pump СЦН-1 through the filter СФ-1 and regulating valve to the jet through which it reaches the internal space of the slinger. With a uniform rotation of the slinger and uniform location of the output fittings on the slinger, the amount of alcohol which reaches eachsection of the blade is uniform.

The alcohol flows under the influence of the centrifugal force from the slinger to the blade fittings, from where through internal passages it reaches the three sections of each blade. At the start of each section, the alcohol enters a channel formed by the nose cap. The alcohol passes along the whole section and is forced by the air flow through orifices in the nose cap onto the nose of the blade, thus washing it. For the purpose of a more uniform washing of the blade, the alcohol is conducted separately to the three sections. The main line of the alcohol supply on the tail rotor is made of copper tubing 4 x 3. It is connected to the jet (#28) for the slinger on the tail rotor.

The jet is attached to the tail rotor transmission. Between the flanges of the main line and the jet there is a washer containing a regulating needle (#26) which regulates the amount of alcohol to the tail rotor.

The slinger of the tail rotor (#27) provides uniform distribution of alcohol to the blades. It consists of a ring of a half circular profile with the open part towards the center of rotation. Three fittings are welded to the outside, uniformly arranged, to which flexible hoses are attached conducting the alcohol to the blades of the tail rotor. The slinger is attached by means of welded lugs to the flange of the hub of the tail rotor. When the pump is on the alcohol is conducted via main line to the jet of the tail rotor and enters the internal space of the slinger and is centrifugally directed through flexible hoses to the blades of the tail rotor.

On each blade of the tail rotor, are stainless steel covers. Between the cover and the nose of the blade, a small channel is formed for the passage of alcohol along the whole length of the blade. The cover is attached to the blade at the root with screws and further to the very tip of the blade by means of copper rivets. The rivet heads are soldered. Due to the centrifugal force the alcohol flows in the channel between the cover and the nose and out through the holes in the cover onto the surface of the blade. Three tubes - (#22), (#23) and (#24) - are provided to drain the system. There is another drain tube (#25) in the main line supplying alcohol to the tail rotor.

3. THE SYSTEM FOR SUPPLYING ALCOHOL TO THE WINDSHIELD

The system for supplying alcohol to the windshield (see Figure #1) consists of a little alcohol tank (#9), a metering valve (#8), lines and windshield wiper AC-2. The alcohol tank of 2.5 liters capacity is welded from AMγA, and has a filler containing a filter. The filler plug has an atmospheric vent. The alcohol tank is attached on padded bands and under the front pylon so that the filler plug is protruding through the outer surface of the pylon. The metering valve (#8) consists of a body (#1), a metering valve with wheel (#2), a spring (#5) and a seal.

The metering valve is attached to the upper edge of the windshield frame. The line from the tank consists of a copper tubing 3 x 2 connecting to a rubber tube glued to the blade of the windshield wiper (#6). The rubber tube has orifices for supplying alcohol to the windshield. The end of this tube is plugged.

Windshield wiper AC-2 consists of electric motor (#3) with a flexible shaft (#4). A mechanism (#7) transforms the rotation into oscillating motion of the blade (#6).

The intensity of icing of the windshield is determined visually and the supply of alcohol is adjusted accordingly by means of the metering valve.

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1. Body of ;the metering valve.
2. Metering valve with wheel.
3. Electric motor of the windshield wiper AC-2
4. Flexible shaft
5. Spring of the metering valve.
6. Blade of the windshield wiper AC-2
7. Oscillating mechanism AC-2
8. Metering valve
9. Alcohol tank
10. Slinger of the main rotor
11. Regulating valve
12. Pressure switch
13. Filter
14.)
15.) Fittings of the tank
16.)
19.)
17. Filler of the tank
18. Tank
20. Alcohol pump
2. Drain tube of the tank
22. Drain from the pump
23. Drain from the main line
24. Drain from the tank
25. Drain from the main line
26. Needle valve
27. Slinger of the tail rotor
28. Jet of the slinger of the tail rotor
29. Fittings
30. Jet of the slinger of the main rotor
31. Regulating needle (valve)
32. Seal of the regulating valve
33. Body of the regulating valve.

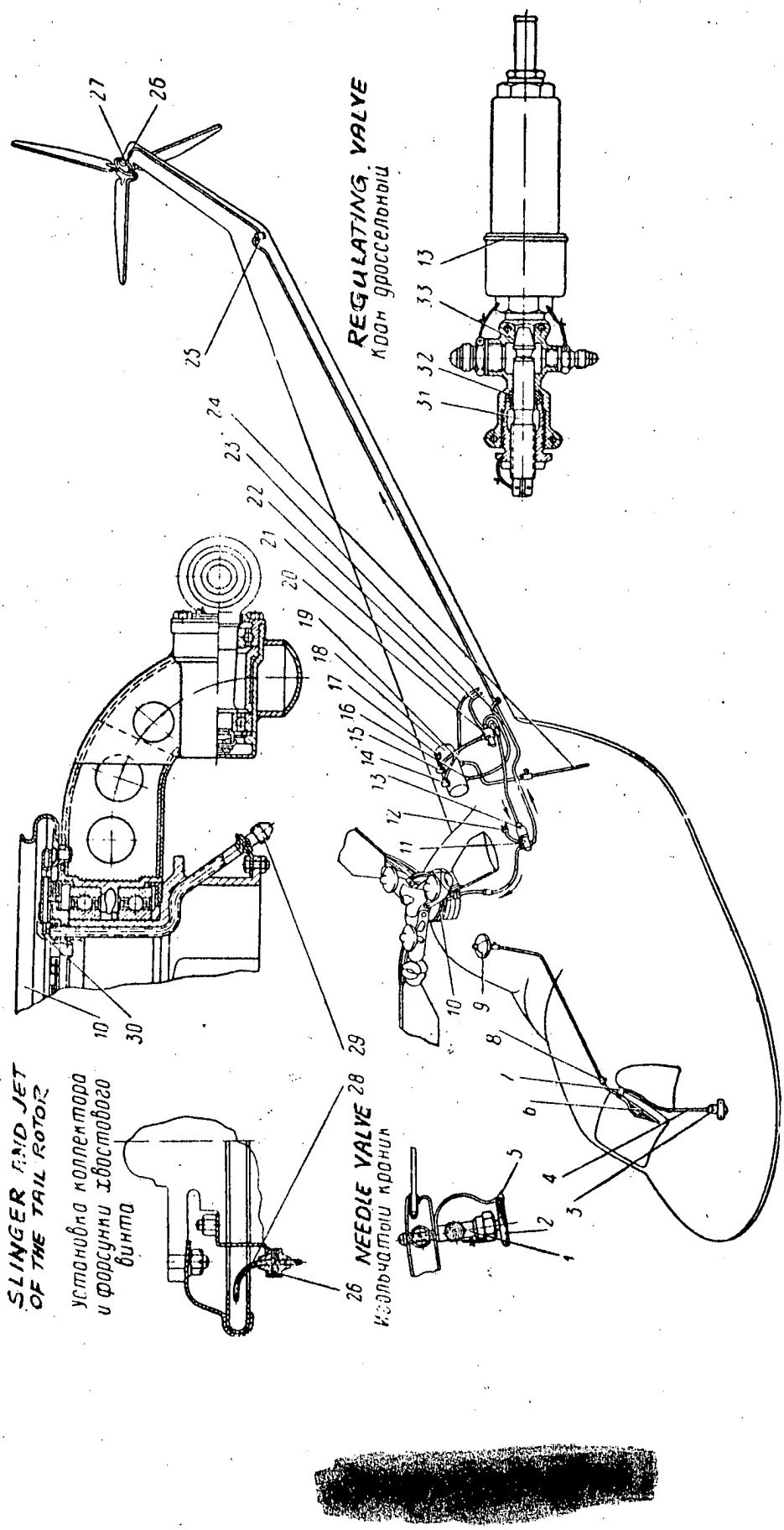

FIG. 1. DIAGRAM OF THE ANTI-ICING SYSTEM

Фиг.1. Схема противообледенительного устройства.

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